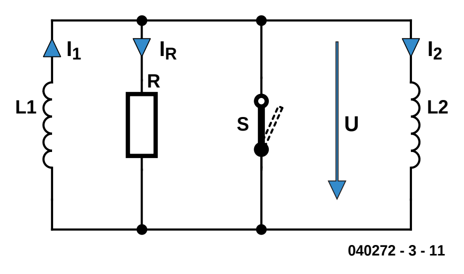
QUIZZ'AWAY

As of the September 2004 issue Quizz'away is a regular feature in Elektor Electronics. The problems to solve are supplied by Professor Martin Ohsmann of Aachen Technical University.

Assuming ideal components are being used and L1 = L2 = 2 mH, inductor L1 initially ($t < 0$) passes a current $I1(0) = 1$ A while for L2 $I2(0) = 0$. At instant $t = 0$ switch S is opened.

How much energy W_R is converted into heat by resistor R if you wait infinitely long?



Hint 1:

$$W_R = \frac{1}{2} L_1 \cdot I_1^2(0) = 1mWs$$

the likely solution for ideal, lossless inductors is not correct in this case.

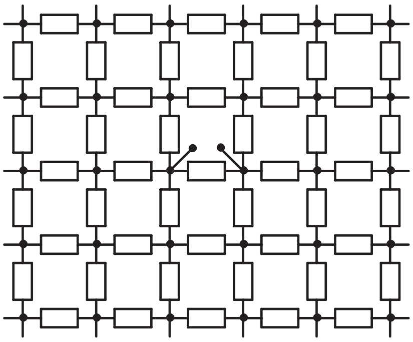
Hint 2:

Make use of 'dual notions' like

voltage ⇔ current
capacitor ⇔ inductor
resistance ⇔ conductivity
charge retention ⇔ ?
electrical energy ⇔ magnetic energy
series network ⇔ parallel network
switch open ⇔ switch closed
perfect conductivity ⇔ perfect isolation

Solution to the September 2004 problem

(p. 80, resistance measured in an infinite array)



Inject a current of 1 mA into one test node; call it node A. By **symmetry** the current will divide equally among the 4 resistors terminating at node A; i.e. 0.25 mA per resistor. Extract a current of 1 mA (the return current) from the test node adjacent to node A; call it node B. Again by symmetry, the current converges in equal values from each of the 4 resistors terminating at node B, i.e., 0.25 mA per resistor.

Using **superposition** and observing the current directions, the injected and extracted currents flowing in the resistor linking nodes A & B are **algebraically summed**, adding up to 0.5 mA through R_{AB}.

A resistance of 1 kΩ × 0.5 mA gives $V_{AB} = 0.5$ V.

For an injected/extracted current of 1 mA,

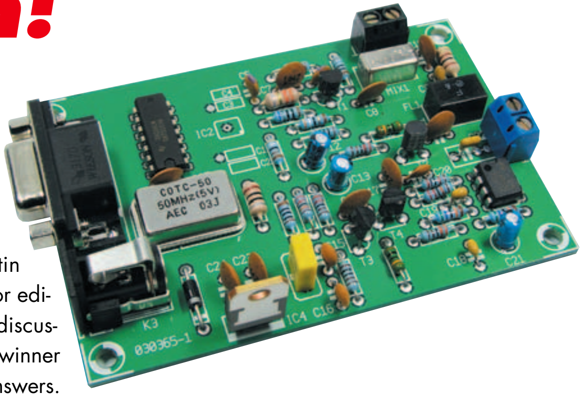
$R_{AB} = 500$ mV/1 mA = 500 Ω.

Quizz'away and win!

Send in the best answer to this month's Quizz'away question and win this

DRM Receiver Board

worth £85 (www.ak-modul-bus.de).



All answers are processed by Martin Ohsmann in co-operation with Elektor editorial staff. Results are not open to discussion or correspondence and a lucky winner is drawn in case of several correct answers.

Quizz'away conditions

Please send your answer to this month's Quizz'away problem by email, fax or letter to:

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Fax (+44) (0)1580 200616.
Email editor@elektor-electronics.co.uk,
subject: 'quizzaway 11-04'.

The closing date is 22 November 2004 (solution published in January 2005 issue). *The outcome of the quiz is final. The quiz is not open to employees of Segment b.v., its business partners and/or associated publishing houses.*